UNIDIR UNITED NATIONS INSTITUTE FOR DISARMAMENT RESEARCH

Stakeholder perspectives on the Biological Weapons Convention

EDITED BY JAMES REVILL, VIVIENNE ZHANG AND MARÍA GARZÓN MACEDA

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Abbreviations

AI	artificial intelligence
CBRN	chemical, biological, radiological and nuclear
CBW	chemical and biological weapons
GCBR	global catastrophic biological risk
IFBA	International Federation of Biosafety Associations
INB	International Network on Biotechnology
ISU	Implementation Support Unit
UNICRI	United Nations Interregional Crime and Justice Research Institute
WHO	World Health Organization
WHOA	World Organisation for Animal Health

Summary

Advancing biological disarmament and wider measures to promote biosecurity cannot be achieved by States Parties to the Biological and Toxin Weapons Convention (BWC) alone. It will require support from stakeholders around the globe. To better understand the role of such stakeholders, UNIDIR sought input from a diverse range of actors on the activities they had undertaken in support of the BWC, what more their respective communities could do and what they thought States should – or should not – do.

The contributions to this volume are not comprehensive, but part of a process of engaging stakeholders. Moreover, the contributions reflect the personal views of the respective authors. Collectively, these contributions provide several concrete ideas for BWC States Parties to consider in seeking to strengthen the Convention, including the following:

Ongoing activities	
Education & training	Education, training and awareness raising on evolving risks surrounding biological weapons
Communication & engagement	Enhanced communication and engagement between different stakeholder communities, including through knowledge exchange on global biological risks
Professional certification	Development of professional certification in biosafety and biosecurity
Diversity & inclusion	Mainstreaming diversity, equity, and inclusion in global biosafety and biosecurity
Disease surveillance	Developing next generation technologies and networks to identify new threats and understand trends in viral evolution
Future institutional activities	
Awareness raising	Further engagement and awareness raising, including with new entities and startups on dual-use issues
Policy guidelines	Consider the development of policy guidelines for technologies converging with the life sciences including biotechnology and artificial intelligence (AI)
Peer review	Create informal peer review initiatives to crowdsource biosafety and security procedures/standards
Identify champions	Identify champions across regions committed to sustainable activities in their respective communities
Inclusion	Inclusion of biosafety and biosecurity professionals and other stakeholders in policy development and implementation
Technological innovation	Further biosurveillance innovations to deliver proactive and pervasive pathogen monitoring

Future activites by BWC States Parties	
Promote existing measures	Promote existing guidelines and measures, including the Tianjin Guidelines and WHO Global Guidance
Increased awareness	Increase awareness on the importance of universalization and implementation of the BWC across the world
Lessons learned	Bring together existing initiatives and actors with top-down support to share lessons learned and best practices
Facilitate collaboration	Facilitate ongoing scientific collaboration across borders and communities to advance biological disarmament and security
Systematic review of S&T	Develop inclusive mechanisms for the systematic monitoring of emerging risks and opportunities in the life sciences, including opportunities for pathogen monitoring

1. Introduction

James Revill, Vivienne Zhang and María Garzón Maceda, UNIDIR

Efforts to enhance biological disarmament and build biosecurity can no longer be achieved by States alone. Input from – and collaboration with – a wide range of stakeholders is required to achieve progress in the implementation of the Biological Weapons Convention (BWC) and wider efforts to strengthen biological security. Yet the perspectives of these different stakeholders are not necessarily always well understood or reflected in biological disarmament diplomacy. Indeed, some stakeholders are almost entirely absent from these discussions.

To address this issue, UNIDIR invited a diverse range of stakeholders to provide their perspectives on the BWC. Specifically, contributors were asked to:

1. Outline activities they had undertaken that could feed into the enhancement of the BWC
2. Provide reflections on what more could be undertaken by their respective organizations or sectors
3. Provide ideas as to what the States Parties to the BWC should do (or not do) to advance the Convention

The views contained in each chapter of this report are those of the authors of the respective chapter alone. As such, they should not be construed as reflecting the views of UNIDIR, the United Nations or indeed the often-diverse communities in which they are embedded. Moreover, the contributions to this volume are not intended to be a comprehensive assessment of all stakeholder perspectives, but rather a first step in a process of engaging a wide range of BWC stakeholders as part of an ongoing UNIDIR project in this area.

While not comprehensive, the views of these and other stakeholders are important: they can provide insight into the challenges and opportunities faced by different stakeholders, as well as food for thought as to possible future activities that BWC States Parties could support.

Ongoing activities in support of the BWC

As the authors of this edited volume demonstrate, there is a rich range of activities currently underway that have the potential to strengthen the BWC. For example, Stephanie Norlock of the International Federation of Biosafety Associations (IFBA) highlights their work on several biosafety and biosecurity initiatives. These include professional certification, South-to-South peer mentorship, and community-led initiatives designed to mainstream diversity and equity and build a more inclusive approach to global biosafety and biosecurity.

Alexander Hamilton outlines the work of the United Nations Interregional Crime and Justice Research Institute (UNICRI) on education and training on evolving risks surrounding biological weapons. This work includes the avancement of responsible life science education through the International Network on Biotechnology, the development of a *Prosecutor's Guide to Chemical and Biological Crimes and the development of a Handbook to Combat Chemical, Biological, Radiological and Nuclear Disinformation*, among other initiatives.

The regional dimension to awareness-raising initiatives is highlighted by Geoffrey Otim from SynBio Africa and Bobadoye Ayodotun, of the Global Emerging Pathogens Treatment Consortium (GET). Otim outlines how this has been achieved through inaugural International Synthetic Biology and Biosecurity Conference

in Africa, as well as work around identifying and responding to catastrophic biological risks. Ayodotun points to the various capacity building programs initiated in African States. And on the technological side, Ryan Morhard of Ginkgo Bioworks provides an overview of how next generation technologies are being applied to develop pathogen monitoring networks designed to identify new threats and understand trends in viral evolution.

Possible future stakeholder activities in support of the BWC

The authors in this volume also present a wide range of further stakeholder actions that could support the BWC in the future. Sean Ekins from Collaborations Pharmaceuticals and colleagues point to the challenges raised by the convergence of biology with AI. In particular, they highlight the importance of raising awareness of potential dual-use risks and developing policy guidelines for the use of AI in pharmaceutical research. They also point to the potential of informal peer review initiatives within the AI-pharmaceutical research community to advance biosafety and security procedures and standards. Providing a biotech industry perspective, Morhard calls for collective stakeholder action to further innovate for biosurveillance through the development of a pathogen monitoring mechanism for global biosecurity.

Paul Freemont, representing the synthetic biology community, suggests that new synthetic biology start-ups, cloud laboratories and biofoundries may be less engaged with the security community than the synthetic biology community was in the past. Engagement between the security community and new start-ups may be required in the future as the field grows and fully matures. Similarly, Hamilton refers to the value of cooperation and collaboration between United Nations entities as well as an inclusive process that integrates experts from new industries or professional stakeholder groups to explore innovative ideas to buttress the BWC. And Norlock of the IFBA highlights the value of bringing together biosafety and biosecurity professionals with their local civil society professional associations, including at BWC-related events.

Options for States Parties to consider

The authors also provide a rich menu of suggestions for the BWC States Parties to consider: Ekins and colleagues emphasize the importance of promoting codes and guidelines, including the Tianjin Biosecurity Guidelines. They also highlight the support for AI training initiatives to mitigate dual-use risks by better identifying these risks from a technical standpoint. Meanwhile, Freemont stresses the importance of international cooperation and, in a period of competition, of continuing collaborative work with other scientists from around the world, both for technological progress and to build greater trust between scientists across national and political borders.

Freemont further highlights the importance of monitoring wider economic and environmental drivers of biotechnological change and the implications these drivers may have for the BWC. In the same vein, Hamilton points to the value of more systematic monitoring of advances in science and technology in order to identify key risks, including the risks posed by social media.

Other authors suggest that there could be a role for BWC States Parties and others in facilitating the creation of networks. For example, Otim points to the value of bringing various regional biosafety and security initiatives together to exchange lessons learned from outreach and engagement, to share materials and to discuss best practices in this area. As a cogent response to the diversity and complexity of individual State Party needs and interests, Norlock proposes the inclusion of diverse global biosafety and biosecurity professionals and their associations in the work to support the implementation of the BWC against the backdrop of an increasingly fragile and fast-moving health security landscape.

Collectively, the contributions from the authors of this volume reflect examples of what has already been done and what is yet possible to achieve. Making the most out of the convening power of the BWC, States Parties can take stock of the different views, challenges, and opportunities of the diverse range of stakeholders in order to create better and stronger synergies to support the goals of the Convention.

2. A perspective from the pharmaceutical industry

Sean Ekins and Fabio Urbina, Collaborations Pharmaceuticals, and Filippa Lentzos, Kings College London

Artificial intelligence (AI) or machine learning methods are increasingly important in pharmaceutical research. As part of the preparation for the 2021 Spiez "Convergence" workshop, Collaborations Pharmaceuticals, Inc. (CPI) explored the theoretical potential of the company's MegaSyn generative approach to demonstrate how this AI-based technology could theoretically be used to design new biologics, including possible chemical and biological weapon (CBW) agents. The results were surprising and stimulated considerable attention among the biosecurity community.

Illustrative activities in support of the BWC

CPI uses AI to help identify therapeutics and means to treat disease, not to make weapons. The company is careful with whom it works. It maintains close control over its proprietary AI software and has not, as yet, licensed MegaSyn technology for further use by researchers outside the company.[1] As such, concerns over dual-uses and biosecurity were, frankly, not a priority for the company, and were only dimly aware of disarmament treaties and security-related concerns.

This changed in 2021 when Sean Ekins and Fabio Urbina from CPI were invited to present at the Spiez Convergence conference on the potential dual-use implications of advances in AI. This conference series is designed to better understand technological developments of relevance to CBW, with a view to strengthening their disarmament regimes.

In preparation for the conference, they tasked their machine-learning models to design molecules with desired bioactivity, toxicity and molecule properties. In six hours, they were able to rapidly generate 40,000 virtual molecules with minimal computational resources. Some of these molecules were predicted to be highly lethal, including VX and known VX analogues. In effect, they had demonstrated the capacity of AI to design virtual nerve agents, such as VX as well as its precursors. The approach could also theoretically be designed to virtually create new (novel) biologics, including possible weapon agents.

The audience at the conference was surprised by this outcome. CPI then collaborated on a publication with two disarmament experts. After several rounds of review and editorial comments, the thought experiment was published and generated significant international attention.[2] For the company, the experiment dramatically raised awareness of the dual-use potential of AI and resulted in what has been described as a "teachable moment" for the field.[3] Subsequently, this work generated considerable discussion about how best to use such generative AI technology. The publication has additionally led stakeholders in the CBW regime to consider the dual-use potential of AI in circumventing CBW regulations.[4]

1 S. Ekins, "Why did we publish on dual use of AI?", Collaborations Pharmaceuticals Blog, 23 March 2022, https://www.collaborationspharma.com/blog/2022/3/23/why-did-we-publish-on-dual-use-of-ai.
2 F. Urbina et al.,"Dual use of artificial-intelligence-powered drug discovery", *Nature Machine Intelligence*, vol. 4, 2022, pp. 189–191, https://www.doi.org/10.1038/s42256-022-00465-9.
3 F. Urbina et al., "A teachable moment for dual use", *Nature Machine Intelligence*, vol. 4, 2022, p. 607, https://doi.org/10.1038/s42256-022-00511-6.
4 M.-M. Blum, "No chemical killer AI (yet)", *Nature Machine Intelligence*, vol. 4, 2022, pp. 506–507, https://doi.org/10.1038/s42256-022-00497-1.

Possible further institutional activities in support of the BWC

The thought experiment was a "wake-up call" and demonstrated how benign technology could be applied to design molecules and potentially new biologics (peptides, proteins, etc.) that could also be toxic and therefore used as weapons.[5] This has implications for both the CBW Conventions and the wider chemical and biological security regime.

There are several future activities that could be considered to strengthen the CBW regime. One useful step could be to work with others in the community to raise awareness of potential risks and perhaps develop policy guidelines around the use of generative and other AI approaches in pharmaceutical research. There are clear incentives for the community to engage with these issues – the hostile use of AI in the development of chemical or biological weapons by any entity would present a considerable reputational risk to the industry as a whole. Moreover, such incidents could result in stringent regulatory measures that prevent the use of these technologies for peaceful purposes, including pharmaceutical research.

An alternative approach to awaiting accidental or serendipity to uncover the dual use potential of AI could be by using "red teaming" (i.e. wilfully misusing a technology to identify critical vulnerabilities in the AI-pharmaceutical research community). For example, a research paper from the AI company Anthropic (Anthropic.com) which works on large AI language models, has already begun to explore the value of red teaming by tasking temporary red teamers with performing attacks on their AI language model to test the system's resistance to harmful content. When used to support chemical and biological security, red teaming could, for example, discover, measure and anticipate innovative methods that certain actors may undertake to breach CBW regimes. Such exercises can enhance the community's knowledge of the strengths and weaknesses of industry and policy perimeters and potentially jump-start risk-reduction measures to address them. However, this should be performed by well-known groups with an awareness of the ethical and legal consequences, and their role should be well-defined and controlled.

Another, alternative or additional step could be for some form of informal community-led "peer review" process of institutional safety and security procedures to ascertain good practices and share learned lessons across the community. Several Biological Weapon Convention-related peer review-type initiatives have already been undertaken around the globe, and the process would demonstrate a proactive approach to safety and security that could help build confidence in the activities of stakeholders.

Recommendations for BWC States Parties

There are several State Party-led activities that can buttress chemical (and biological) security. These include learning from the Hague Ethical Guidelines on the misuse of chemistry and other, biosecurity-focused measures, such as the Tianjin Biosecurity Guidelines for Codes of Conduct for Scientists.[6]

5 F. Urbina et al., "AI in drug discovery: A wake-up call", *Drug Discovery Today*, vol. 28, iss. 1, January 2023, https://doi.org/10.1016/j.drudis.2022.103410.

6 See the Tianjin Biosecurity Guidelines for Codes of Conduct for Scientists at https://www.centerforhealthsecurity.org/our-work/Center-projects/IAPendorsementTianjinCodes/20210707-IAP-TianjinGuidelines.pdf.

The States Parties could also engage with the community, drawing lessons from the experience in the mid-2000s with the synthetic biology community (see chapter 2 in this volume). Such a step could help encourage the creation of a field of "AI ethics in drug discovery" and, perhaps most importantly, support initiatives designed to train those using AI in drug discovery to more effectively recognize the dual-use potential of generative AI.

CPI has provided an early, real-world case study of dual-use AI–pharmaceuticals convergence. With the growing use of AI in this area, this is unlikely to be the last case of AI being misused, and other actors may not act so responsibly in the future. Efforts to prohibit and prevent this sort of misuse, therefore, require consideration by States and other stakeholders, including in discussions under the BWC.

3. A perspective from the synthetic biology community in Europe Paul Freemont, Imperial College London

Synthetic biology is an engineering discipline born in the 2000s with the aim of developing new tools and processes to manipulate biological systems at the genetic level. It is a platform technology that could provide a variety of sustainable applications, ranging from healthcare to food, and from the environment to energy.

The field has achieved much since its infancy in the 2000s, including the development of minimal synthetic bacterial genomes and the synthetic production of artemisinic acid – a key precursor in anti-malarial drugs.[1] However, engineering biology has proven to be remarkably difficult, with multiscale biological interactions confounding predictability. Attempts to address this include the establishment of cloud-accessible biofoundry facilities which comprise high-throughput automated robotic and analytical infrastructure to accelerate the synthetic biology Design-Built-Test-Learn cycle.[2] Such developments are also fuelling advances in applying AI/ML to synthetic biology, with the ultimate goal of establishing rational design rules for engineering organisms at the genetic level for specific applications.[3]

At this current juncture, synthetic biology and biotechnology generally are receiving increased attention. This is driven less by the concerns of the security community and more by wider policy drivers, including planetary and human health, economic factors and the need to adopt sustainable biomanufacturing processes to remove the reliance on petrochemical-derived products. This may have a significant bearing on arms control and disarmament instruments designed to contribute to biological disarmament- and biosecurity-related activities.

Illustrative activities in support of the BWC

In the mid-2000s, synthetic biology attracted considerable attention from the security community, including the States Parties of the Biological Weapons Convention. For example, one State Party expressed concerns over the potential for synthetic biology to enable "small-scale research groups and even some individuals ... to make the deadly Ebola and smallpox viruses and even some viruses against which all drugs are ineffective, thus making it much harder to counter bioterrorism".[4]

This resulted in a dialogue between some in the synthetic biology community and those working on security issues, including law enforcement actors that reached out to the scientistic community and provided a point of contact to raise concerns they may have.

1 C.A. Hutchison III et al., "Design and synthesis of a minimal bacterial genome", *Science*, vol. 351, iss. 6280, 2016, https://www.science.org/doi/10.1126/science.aad6253; C.J. Paddon and J.D. Keasling, "Semi-synthetic artemisinin: a model for the use of synthetic biology in pharmaceutical development", *Nature Reviews Microbiology*, vol. 12, no. 5, April 2014, pp. 355–367, https://doi.org/10.1038/nrmicro3240.

2 N. Hillson et al., "Building a global alliance of biofoundries", *Nature Communications*, vol. 10, art. 2040, May 2019, https://doi.org/10.1038/s41467-019-10079-2.

3 J. Chao, "Machine Learning Takes on Synthetic Biology: Algorithms Can Bioengineer Cells for You", News From Berkeley Lab, 25 September, 2020, https://newscenter.lbl.gov/2020/09/25/machine-learning-takes-on-synthetic-biology-algorithms-can-bioengineer-cells-for-you.

4 Seventh BWC Review Conference, New scientific and technological developments relevant to the Convention – Background information document submitted by the Implementation Support Unit – Addendum, BWC/CONF.VII/INF.3/Add.1, 3 November 2011, https://documents-dds-ny.un.org/doc/UNDOC/GEN/G11/648/39/PDF/G1164839.pdf?OpenElement, p. 4.

This has helped raise awareness of concerns over the potential hostile exploitation of biology and biological technologies. Indeed, the process perhaps reflects an under-remarked success story, and several entities working on synthetic biology have taken this even further. The International Genetically Engineered Machine (iGEM) competition, for example, has led to innovation in biosecurity and biosafety measures by raising awareness and "building procedures and practices" into the competition.

Possible further institutional activities in support of the BWC

We are in a new biological technology era that has the potential to disrupt many industrial sectors. Synthetic biology already presents a huge economic opportunity and has already accrued some $40 billion in private funding for synthetic biology companies, primarily in the United States. Moreover, the market is growing, with the market size for synthetic biology estimated to reach $33.2 billion by 2026, at a compound annual growth rate of 28.4% between 2021 and 2026.[5] As States seek to employ biotechnology as a more sustainable and valuable means to address societal challenges and to transition to a circular bioeconomy, the field is likely to grow considerably, particularly as large States, including the United States and China, are prioritizing biotechnology. This may potentially lead to a global biomanufacturing race.

In parallel, we have seen growth in the use of synthetic biology-related tools. At present, around 3 million bases are synthesized globally per year. The cost of synthesizing DNA will continue to decrease, making the procedure more widely available through benchtop synthesizers and the automation of construction cycles in cloud laboratories and biofoundries. Emerging synthetic DNA designs, designers and organisms are very difficult to trace back, creating challenges for accountability and the misuse of synthetic biology. It is unclear whether new synthetic biology start-ups, cloud labs and biofoundries are attracting the same level of attention from the security community as the field of synthetic biology did, and it seems that there is little discussion on dual-use in early-stage synthetic biology start-ups. Perhaps further engagement between the security community and new actors in start-ups will be required in the future as the field grows and fully matures.

Recommendations for BWC States Parties

In the current environment of high geostrategic tensions, States need to be careful not to undermine ongoing scientific collaboration. Geostrategic tensions have already shut the door to fruitful collaborations and have divided scientific communities. Working openly with other scientists from around the world is important for technological progress as well as building greater trust between scientists across national and political borders.

Furthermore, pandemics such as COVID-19 have global consequences – scientists need to be able to work transparently across borders, to jointly tackle some of the biggest existential threats the world now faces. The BWC States Parties will be unlikely to control these wider dynamics, but they need to consider these trends in seeking to advance work on biological disarmament and biosecurity.

5 BCC Research, Synthetic Biology: Global Markets, 2021, https://www.bccresearch.com/market-research/biotechnology/synthetic-biology-global-markets.html.


WHY ME?!
SOME ARE MORE ATTRACTIVE TO MOSQUITOS THAN OTHERS...
CELLS KNOW ABOUT TIME
with EUROPEAN RESEARCH COUNCIL
TRANSFORMING HEALTHCARE with SYNTHETIC BIOLOGY
the POTENTIAL of SYNTHETIC BIOLOGY
LET'S FEED the WORLD
WILL THIS WORK WITH MY GUT MICROBES?
ALLERGIES BY PROCESSING FOOD...
CELLS MAKE DECISIONS
AGEING and the MICROBIOME
A HEALTHY GUT the KEY FOR a SHARP BRAIN, STRONG HEART, BONES & MUSCLES and IMMUNE SYSTEM?
LESS DRUGS!
the BACTERIA in your GUT
HIGH COST
DEMENTIA
HEART DISEASE
DIABETES
NUTRITION IMPACT
★PROBIOTICS
★CARBOHYDRATES
★FAT
POTENTIAL in PROBIOTICS
CUSTOMIZED TREATMENT
NOT FAST ANTIBIOTICS
RESISTANCE
FUNGI

4. A perspective from the synthetic biology community in Africa Geoffrey Otim, SynBio Africa

SynBio Africa was established in 2018 as a synthetic biology platform designed to bring together scientists, researchers, policy-makers, academics, students and the wider community from across Africa to explore the benefits of synthetic biology. It has a particular focus on developing the regional bioeconomy through healthy, safe and sustainable work on synthetic biology.[1]

Illustrative activities in support of the BWC

The group has undertaken work on several thematic issues, such as biosafety and biosecurity. This has been addressed through workshops and events designed to raise awareness of biosecurity- and safety-related issues. One example is the inaugural International Synthetic Biology and Biosecurity Conference in Africa, which took place in October 2021 in Kampala, Uganda.[2]

SynBio Africa has also launched the Global Catastrophic Biological Risks (GCBR) Initiative, which is designed to grow Africa's capacity to combat them.[3] This project has several goals:

- To create awareness and knowledge sharing on GCBRs
- To advocate for the adoption and implementation of legal frameworks
- To identify and control potential GCBR pathogens before they are beyond containment
- To prevent highly counterproductive responses that could turn a potentially manageable biological event into a widespread economic, civil, or security catastrophe

Possible further institutional activities in support of the BWC

A lot of people are interested in and willing to work on biosecurity and biosafety. To proceed, we need champions across the region to pursue steps to build biosecurity and biosafety.

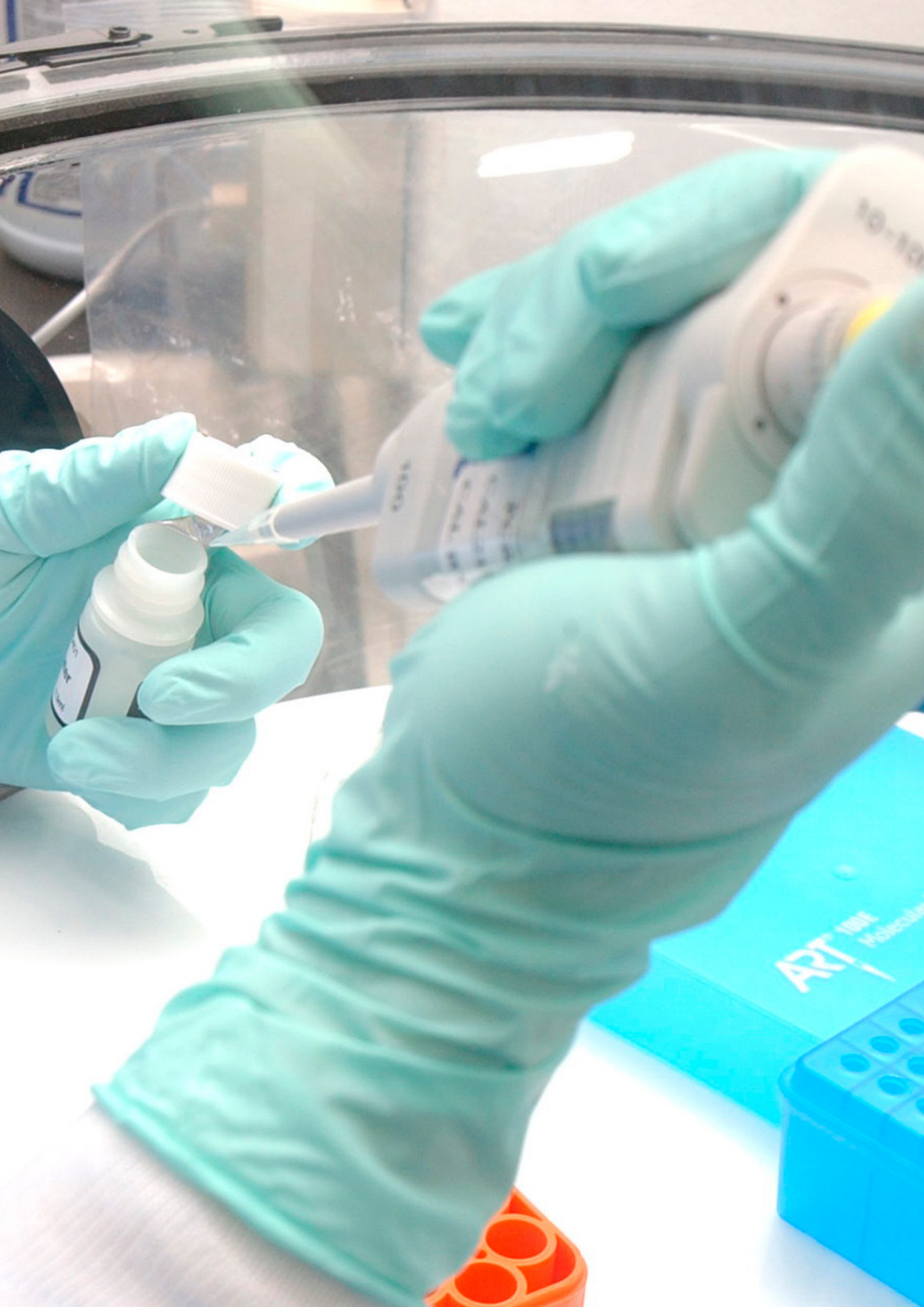
One thing we hope will be fruitful is the approach taken at past workshops where we make sure that individuals come up with commitments on what they are going to take back to their respective communities and follow up on. In this way, we can continue the process and hopefully sustain engagement.

Recommendations for BWC States Parties

There are several regional initiatives taking place. One useful step could be to try and bring these initiatives together to exchange lessons learned from the process, share materials and discuss best practices in this area. Such a step will likely require some top-down support and facilitation that States Parties of the Biological Weapons Convention could provide.

Groups like ours also need resources and support to help customize training materials for participants to understand global catastrophic biorisks and wider biosecurity and biosafety measures in relation to the local context.

1 "About us", SynBio Africa. https://synbioafrica.com.
2 "International Synthetic Biology and Biosecurity Conference in Africa", SynBio Africa, https://synbioafrica.com/conference.
3 "Global Catastrophic Biological Risks Initiative", SynBio Africa, http://gcbri.synbioafrica.com/index.php.



5. A perspective from biosafety and biosecurity professionals Stephanie Norlock, International Federation of Biosafety Associations

Events in recent years across the spectrum from biosafety to biosecurity – including the ongoing COVID-19 pandemic and geopolitical conflicts – have mainstreamed interest in the safe, secure and responsible handling of biological materials, related technologies and relevant information. Despite increasing will across levels of leadership, across professional sectors, and across regions, policy in support of the implementation of biological weapon non-proliferation and disarmament remains underdeveloped. In May 2022, the United Nations Under-Secretary-General and High Representative for Disarmament Affairs, Izumi Nakamitsu, noted that international biological non-proliferation policy architecture remains less funded than its nuclear and chemical counterparts.[1]

Illustrative activities in support of the BWC

It has been argued that gaps in global biosecurity policy – including gaps in the sustainable and universalized implementation of global biosecurity policy – have been narrowed in large part by the contributions of frontline workers such as biosafety and biosecurity professionals. Indeed, much of the formalized global biosecurity landscape is supported by dynamic, human-centric efforts that require expertise at the junction of science, policy and security. One example of the approaches that have supported the implementation of the BWC in recent years is the consideration of model codes of conduct among scientists and those handling biological materials, technology, or information with dual-use potential.[2] Another example is the strategies that encourage intersectoral work to address complex health security issues (e.g., use of the One Health framework).

The efforts of biosafety and biosecurity professionals cannot be understated when considering their mitigation of safety and security risks as part of their respective State's responses to the COVID-19 pandemic.[3] Because biosafety and biosecurity professionals as well as their local civil society professional associations are conveniently dispersed across global biosecurity policy design and implementation spheres, they have a strong part to play as regular key contributors to multilateral BWC dialogues and national implementation strategies.

Possible further institutional activities in support of the BWC

Biosafety and biosecurity professionals may work as dedicated biosafety officers in field or laboratory settings, however, others include scientists, other laboratory personnel, architects, engineers, academics, and policymakers. This diversity in the global biosafety and biosecurity workforce lends an important advantage to national and transnational BWC implementation, where decision-makers and workers invested in biological disarmament and non-proliferation are keenly aware of the local and sector-specific obstacles to BWC universalization.

1 I. Nakamitsu, "Open remarks at the Open Consultations on the Comprehensive Review of the Status of Implementation of Resolution 1540 (2004)", Speech, New York, 31 May 2022, https://front.un-arm.org/wp-content/uploads/2022/06/HR-Remarks-Open-Consultations-on-the-Comprehensive-Review-of-the-Status-of-Implementation-of-Resolution-1540.pdf.

2 T. Novossiolova and M. Martellini. "Promoting responsible science and CBRN security through codes of conduct and education", *Biosafety and Health*, vol. 1, iss. 2, September 2019, pp. 59-64, http://dx.doi.org/10.1016/j.bsheal.2019.08.001.

3 K.L. Warmbrod et al., "Biosafety Professionals: A Role in the Pandemic Response Team", *Health* Security, vol. 19, no. 4, 16 August 2021, https://doi.org/10.1089/HS.2021.0015.

National and regional biosafety and biosecurity professional associations perform important "on-the-ground" work in the formalization and sustainability of the biosafety and biosecurity practices that support BWC implementation. These associations effectively build local capacity through initiatives such as technical training and certification and in developing national biosafety and biosecurity legislation and supporting policies.[4] They also help to develop transnational networks and advocacy initiatives through direct participation in BWC meetings and workshops. As global biosafety and biosecurity practices have shifted to the risk assessment method, which is more heavily reliant on competent human resources, local biosafety and biosecurity associations and the work that they conduct should be considered as critical components of the health security landscape of their country or region.

These associations may be considered an exceptional resource which could be leveraged by governance from above to innovate policy solutions and recommend more acessible or sustainable methods to implement the articles of the BWC. This point is particularly important to consider for the effective implementation of Article X, where biosafety and biosecurity professional associations are well-placed to understand – and advocate for – national and regional needs as it pertains to equitable and responsible use of emerging technologies. They are also well-placed to mitigate the unique risks that may pose as obstacles to their equitable and responsible use.

Recommendations for BWC States Parties

There are many opportunities for the BWC States Parties to include their national or regional biosafety and biosecurity associations in ongoing work within and outside formal BWC meetings. As noted, some associations directly attend meetings and collaborate with other like-minded civil society groups and multilateral organizations, where prominent association members often individually serve as local champions in transnational biosecurity diplomacy roles.

The International Federation of Biosafety Associations (IFBA), a regular member of the civil society community that supports the BWC, represents the interests of its entire member base, which includes over 45 national and regional biosafety associations worldwide. Through its central programming, the IFBA provides several opportunities for investment in and connection with the biosafety and biosecurity professionals who effectively serve as many States Parties' "boots on the ground" in safeguarding national and regional health security. These programmes include professional certification, South-to-South peer mentorship and community-led initiatives that mainstream diversity, equity and inclusion in global biosafety and biosecurity. These efforts also support integration of groups that are often under-represented across global non-proliferation and disarmament forums – including women, youth, and professionals from across the Global South – into meaningful participatory roles. As a global unifying body for its member biosafety and biosecurity associations, in addition to several observer organizations, the IFBA places priority on working towards global biosafety and biosecurity decision-making that strives to include and benefit all.

4 T. Brown. "Project on biosafety and biosecurity in Mali concludes," VERTIC, 17 January 2020, https://www.vertic.org/2020/01/project-on-biosafety-and-biosecurity-in-mali-concludes.

Against the backdrop of an increasingly fragile and fast-moving health security landscape, the BWC States Parties should include diverse global biosafety and biosecurity professionals and their associations in work supporting the implementation of the BWC. This will provide a cogent response to the diversity and complexity of individual State Party needs and interests. The outcomes from bolstered international representation across national delegations and civil society could include increased international cooperation and shared work to support developing the global biosecurity policy architecture.

Where increased diversity of expertise and experience lends creativity and opportunity for innovation in this regard, it also underlines a shared responsibility to prevent and mitigate biological threats as society's understanding and use of science and technology progresses on paper and at the laboratory bench.

6. A perspective from the biotech industry community

Ryan Morhard, Ginkgo Bioworks

Ginkgo Bioworks is building a platform to enable customers to program cells as easily as we can program computers. Customers use our platform to enable biotechnology applications across diverse markets, from food and agriculture to industrial chemicals to pharmaceuticals.

As the costs of biological engineering drop, and as production processes utilize automation, artificial intelligence, and data-analytics, the applications of biotechnology are moving beyond health care. In fact, many, if not most, of the cutting-edge applications of biotechnology that will shape the bioeconomy are outside of the human health sector. Increasingly, biotechnology contributes to products and processes we rely on for agriculture, food, consumer goods and services, materials, and energy.

As the bioeconomy grows, and as more and more sectors begin to use biotechnology, biosecurity is beginning to resemble modern approaches to cybersecurity. In the same way that cybersecurity is necessary for computer infrastructure, biosecurity is necessary to realize the full potential of what looks to be the biological century.

Illustrative activities in support of the BWC

At Ginkgo, we are also building next generation technologies and systems to limit disruptions caused by biological threats. The global response to COVID-19 accelerated our efforts to work with key stakeholders to provide end-to-end biosecurity tools to enable next-generation pathogen detection and response. Specifically, Ginkgo delivers one of the largest operating pathogen monitoring networks in the US, and has tested over 10.99 million samples across thousands of schools, airports, correctional facilities, and other congregate settings. We sequence samples at our facilities and through our lab partner network to identify new threats and understand trends in viral evolution and have sequenced over 42,000 SARS-CoV-2 samples to date.

Ginkgo's traveler-based SARS-CoV-2 genomic surveillance program plays an important role in national public health security by providing an early warning system and critical information about emerging variants entering the United States. The airport testing program detected Omicron sublineages BA.2 and BA.3 weeks before they were reported by other organizations — creating early opportunity for characterization and analysis.[1]

Importantly, this large-scale footprint provides infrastructure for introducing a passive surveillance layer. Passive biosurveillance of environmental samples, such as those from wastewater and air, will be essential to ensuring that the early warning and monitoring technologies meant to prevent the spread of infectious diseases are layered, pervasive, and formidable. Unlocking this layer requires innovation to utilize the right set of modalities to establish baselines that allow public health leaders to rapidly identify and respond to anomalous events.

1 See: E. Anthes. "C.D.C. Airport Surveillance Found the First Known U.S. Case of BA.2". The New York Times, 24 March 2022. https://www.nytimes.com/2022/03/24/health/cdc-us-ba2.html.

Of particular interest to the BWC community, Ginkgo has also worked with the U.S. government's Intelligence Advanced Research Projects Activity (IARPA) to develop a suite of new computational tools to help detect and identify when samples include genetically engineered biological systems.[2] Until now, methods for detecting signs of biological engineering have typically been costly, slow, and capable of detecting only a subset of all possible genetic modifications. New tools now make it possible for scientists to detect engineered DNA at scale.

Possible further institutional activities in support of the BWC

Advancements in biotechnology are finally enabling the types of pathogen monitoring that public health and biosecurity practitioners have long been seeking. Since the beginning of the pandemic, the widespread biosurveillance now emerging in parts of the world was impractical (if not impossible) just five or ten years ago. Governments, academia, the private sector, and civil society should commit themselves to further innovating for biosurveillance – especially to deliver proactive and pervasive pathogen monitoring for global biosecurity.

Recommendations for BWC States Parties

States Parties to the BWC should recommit themselves to the Convention, and, in particular, to working together to build the important health security capacities that fight pandemics *and* address the threat posed by biological weapons. States Parties should also embrace the expanding applications of biotechnology around the world and across all sectors of the economy. These technologies provide a transformational opportunity for sustainable public health capacity.

Policymakers around the world should take full advantage of the growing global bioeconomy in improving pandemic preparedness and response strategies and capabilities. The bioeconomy of the future offers our best shot to end the panic-and-neglect cycle in pandemic policies; develop better tools for preventing, detecting, and responding to epidemics and pandemics; and support sustainable development around the world.

2 R. Griffin. "Ginkgo Is Trying to Detect Future Man-Made Biological Threats". Bloomberg, 17 October 2022. https://www.bloomberg.com/news/articles/2022-10-17/ginkgo-is-trying-to-detect-future-man-made-biological-threats.

7. A perspective from the Global Emerging Pathogens Treatment Consortium

Bobadoye Ayodotun, Global Emerging Pathogens Treatment Consortium

The increasing frequency of infectious disease outbreaks in Africa and the damaging effects of such diseases on societies – whether natural, accidental, or deliberate – points to the importance of the effective implementation of Biological Weapons Convention (BWC) across the continent. With the exception of Chad, Comoros, Djibouti, Eritrea and South Sudan, all countries have either signed or ratified the BWC. However, implementation is sometimes underdeveloped. As such there is a need for collaboration between stakeholders, government organizations, academia, NGOs, and industry to ensure the effective implementation of the BWC in African States. The strategic role of non-governmental organizations, such as the Global Emerging Pathogens Treatment Consortium (GET), in creating awareness, building capacity and providing policy advice on issues related to the BWC implementation cannot be overemphasized.

The GET Consortium was established at the height of the Ebola outbreak in August 2014 in Lagos, Nigeria. The Consortium was designed to bring together medical, governance and project management experts from all the geopolitical regions of Africa in the pursuit of an indigenous, multi-sector response to biological threats on the continent. The Consortium is currently comprised of over 140 African experts from diverse backgrounds. It functions as a biosecurity think tank and implementation organ that aims to provide recommendations on strategies and policies to African governments and agencies as well as fostering research and building capacity through various initiatives and projects.

Illustrative activities in support of the BWC

GET's activities and efforts in the implementation of BWC in Africa are numerous. One highlight is the annual African conference on One Health and Biosecurity that the Consortium has consistently organized since 2014. This conference focuses on biosecurity concepts, including the BWC and related subjects, vaccine strategies, measures to mitigate biosecurity threats, global health security and public learning.[2]

Since its inception, GET has also embarked on various capacity building programs in different African States. The aim is to develop capacity in biobanking[3] and biosecurity regulations, as well as related policies that can then mature into specific national legislation or related governance measures that improve compliance with the Convention. In once recent case, GET developed the Biosecurity policy for countries of the Economic Community of West African States (ECOWAS). The final draft was presented at the West Africa Health Organization (WAHO) Annual meeting in Lomé, Togo, on 31 March 2021.

Another notable example from 2015 is the Consortium's work on conceptualizing a data and sample rescue project to secure thousands of remnant Ebola-positive samples and their associated data in affected countries. The objective was to generate an invaluable academic resource aimed at providing material for peaceful purposes to advance the understanding of Ebola, at the same time as protecting the communities from accidental discharge or theft of these samples.

1 See the 2022 edition of the Conference at https://www.getafrica.org/events/conference-2022.
2 Biobanking is the process of collecting, annotating, storing and redistributing biological samples in order to facilitate research designed to improve understanding of health and diseases.

Finally, the GET consortium and United Nations Office for Disarmament Affairs (UNODA) collaborated by jointly organizing a side event on the margins of the annual meeting of States Parties to the Biological Weapons Convention on 21 November 2021. GET has also participated in and given presentations to various meetings of the BWC and the 1540 Committee over the last couple of years.[3]

Possible further institutional activities in support of the BWC

The universalization and implementation of BWC in Africa faces several challenges that require a collaborative and transdisciplinary response. Effective communication of the importance of universalization and implementation of BWC to relevant stakeholders is one of the main challenges in Africa.

There is currently little information available the enactment of BWC-related national legislation in African. And reporting under the Confidence Building Measures process is perceived as overly burdensome, technically difficult and time-consuming. Collectively, States Parties to the BWC have been inconsistent in monitoring and reporting on the requirement to adopt national measures to implement the treaty's prohibitions. Another critical challenge to the universalization and implementation of BWC in Africa is funding. Funding of the Implementation Support Unit, the Convention as a whole, and the NGO community remains a critical issue.

Recommendations for BWC States Parties

In order to strengthen the universalization and implementation of the BWC in Africa, the following measures are recommended: first there is a need for increased advocacy and awareness on the importance of universalization and implementation of the BWC in African States. Second, increased and continuous training and capacity building of stakeholders, including legislators, policy-makers, academia and non-governmental organization staff is required. Third, there is a need for the development and implementation of national governance structures that will enforce the implementation of relevant laws and policies. Finally, increased funding of BWC activities across the region is needed. The GET Consortium urges States Parties to pay their assessed annual contributions in full and as early as possible and for those in a position to do so, contribute to the BWC Working Capital Fund.

3 See for example: BWC Meeting of State Parties, 14 December 2015, https://www.getafrica.org/wp-content/uploads/2022/08/2022-0812-Final-report-Coordination-Workshop.pdf. Eight BWC Review Conference, 7th to 25 December 2016, https://www.getafrica.org/wp-content/uploads/2018/02/GET-Statement-to-the-BWC-RevCon-November-2016.pdf. Open consultations of the Committee on the comprehensive review of the status of implementation of resolution 1540 (2004) from 31 May to 2 June 2022, https://www.getafrica.org/wp-content/uploads/2022/08/Statement-by-GET-COO-at-the-UN-Open-Consultation-2022.pdf. Coordination Workshop for the Project on 'Supporting Universalization and Effective Implementation of the BWC in Africa', 26-27 July 2022, https://www.getafrica.org/wp-content/uploads/2022/08/2022-0812-Final-report-Coordination-Workshop.pdf.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8. A perspective from the United Nations Interregional Crime and Justice Research Institute

Alexander Hamilton, United Nations Interregional Crime and Justice Research Institute

The United Nations Interregional Crime and Justice Research Institute (UNICRI) is mandated to design and implement improved policies and actions in the field of crime prevention and control. It supports governments and the international community at large in tackling criminal threats to social peace, development and political stability. UNICRI seeks to achieve four general objectives with its work: to advance understanding of crime-related problems; to foster just and efficient criminal justice systems; to support the respect of international instruments and other standards; and to facilitate international cooperation in law enforcement and judicial assistance.

Illustrative activities in support of the BWC

UNICRI has taken steps to enhance biosafety and biosecurity under its Chemical, Biological, Radiological and Nuclear (CBRN) Risk Mitigation and Security Governance Programme. The wide range of activities implemented under this framework in support of the Biological Weapons Convention demonstrates the collaborative nature of UNICRI's initiatives and evolving developments in the biological field. UNICRI works closely with international partners engaged in complementary missions, including the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the BWC Implementation Support Unit (ISU), the World Organisation for Animal Health (WOAH), INTERPOL and others to provide expertise and to co-implement joint projects and activities in support of the BWC. UNICRI participates in BWC Meetings of Experts and Meetings of States Parties and WHO's Health Security Interface–Technical Advisory Group (HSI-TAG), and it serves as a member of the United Nations Biorisk Working Group. In collaboration with WOAH's work to mitigate and prosecute biothreats (agri-crime and agroterrorism), UNICRI has engaged in the development of guidelines, tabletop exercises and joint training activities. UNICRI also addresses dual-use research of concern jointly with WHO, WOAH and other stakeholder organizations.

Aside from co-implementing projects with international organizations, the impact of UNICRI's partnerships with States and governments extends globally as well. For example, the European Union CBRN Risk Mitigation Centres of Excellence Initiative, jointly implemented by the European Union and UNICRI, is a global programme spanning eight Regional Secretariats and 64 Partner Countries. This initiative supports Partner Countries in strengthening national, regional and international capacity to prevent, detect and respond to CBRN risks. These include disease events that are natural (e.g. COVID-19), accidental (e.g. laboratory accidents), or deliberate (e.g. bio/agroterrorism).[1]

UNICRI also administers the International Network on Biotechnology (INB) – a global network of academic and research institutions committed to advancing education and raising awareness about responsible and secure conduct in the life sciences. The initiative results from a collaboration between UNICRI and the United States Federal Bureau of Investigation (FBI). It focuses on the latest research and development in the life sciences

1 EU CBRN Risk Mitigation Centres of Excellence", European Union Chemical, Biological, Radiological and Nuclear Risk Mitigation, https://cbrn-risk-mitigation.network.europa.eu/index_en.

and biotechnology and supports the co-development and sharing of innovative educational and training materials covering the subject areas of biosafety, biosecurity and bioethics.[2]

UNICRI is the co-chair of the Working Group on Emerging Threats and Critical Infrastructure Protection (ETCIP) under the United Nations Global Counter-Terrorism Coordination Compact. Within the framework of this Working Group, UNICRI, in cooperation with the United Nations Counter-Terrorism Centre (UNCCT) of the United Nations Office of Counter-Terrorism (UNOCT), produced the report *Advances in Science and Technology to Combat Weapons of Mass Destruction (WMD) Terrorism* in 2021. The objective of the report is twofold: first, to understand possible risks associated with the malicious use of science and technology to develop and deploy WMD, and second, to identify scientific and technological solutions that can be used to fulfil United Nations Member States' needs in terms of preventing and combatting WMD terrorism. Also within the framework of this Working Group, UNICRI is developing the terms of reference (ToR) for an Inter-Agency Network of Focal Points Against Chemical and/or Biological Attacks. The network will facilitate communication between participating agencies in order to exchange information and coordinate activities in relation to chemical or biological attacks.[3]

Recently, UNICRI contributed to an initiative to boost judicial capacity in handling chemical or biological incidents. In May 2022, it published the *Prosecutor's Guide to Chemical and Biological Crimes* in cooperation with the Organisation for the Prohibition of Chemical Weapons (OPCW), the International Association of Prosecutors (IAP) and the BWC ISU, which assisted with the revision of the document. A series of capacity-building and training courses were developed to integrate the guide into the professional duties of prosecutors, judges, investigators and other law enforcement authorities. An additional guidebook, the Chemical and Biological Crime Scene Management Guidebook, will be developed by UNICRI in close cooperation with its partners to strengthen the biosafety and biosecurity knowledge of police and law enforcement on the ground.

Media and social media can be used maliciously in the creation and spread of deliberately deceptive information about CBRN threats. This can potentially cause political, financial and physical harm to governments, international organizations, the scientific community, industry and the wider public. To keep pace with such threats, in the past three years, UNICRI has been monitoring and analysing the malicious use of disinformation on CBRN risks. In a report published in November 2020, UNICRI describes how violent non-State actors have been trying to take advantage of the pandemic to undermine trust in governments while simultaneously reinforcing non-State actors' extremist narratives, calling for violence and promoting recruitment strategies.[4]

To strengthen the institutional response to these dangers, UNICRI will soon publish a *Handbook to Combat CBRN Disinformation*. It is designed for practitioners and entities working in CBRN risk mitigation at different levels (e.g. decision-making, strategic communication, management, operations, etc.) that have been or could potentially be exposed to and targeted by disinformation. The Handbook addresses the phenomenon in two ways: first, to understand the problem of CBRN disinformation on social media; and second, to develop a set of competencies to effectively prevent and respond to disinformation on social media platforms with a specific focus on techniques

2 "INB Overview", International Network on Biotechnology, https://inb.unicri-projects.it/inb-overview.
3 The ToR is an output of the project *Ensuring Effective Interagency Interoperability and Coordinated Communication in Case of Chemical/Biological Weapons Attacks* (Phase III) implemented by OPCW.
4 United Nations Interregional Crime and Justice Research Institute, Stop the Virus of Disinformation: the risk of malicious use of social media during COVID-19 and the technology options to fight it, November 2020, https://unicri.it/sites/default/files/2021-01/misuse_sm_0.pdf.

for debunking false information. UNICRI is also launching a Centre to Combat Disinformation to support States in identifying the techniques, tactics and strategies used in the dissemination of disinformation and the possible methods to combat it, including debunking approaches, technology tools and the use of strategic comunication to anticipate and respond to false claims.

Possible further institutional activities in support of the BWC

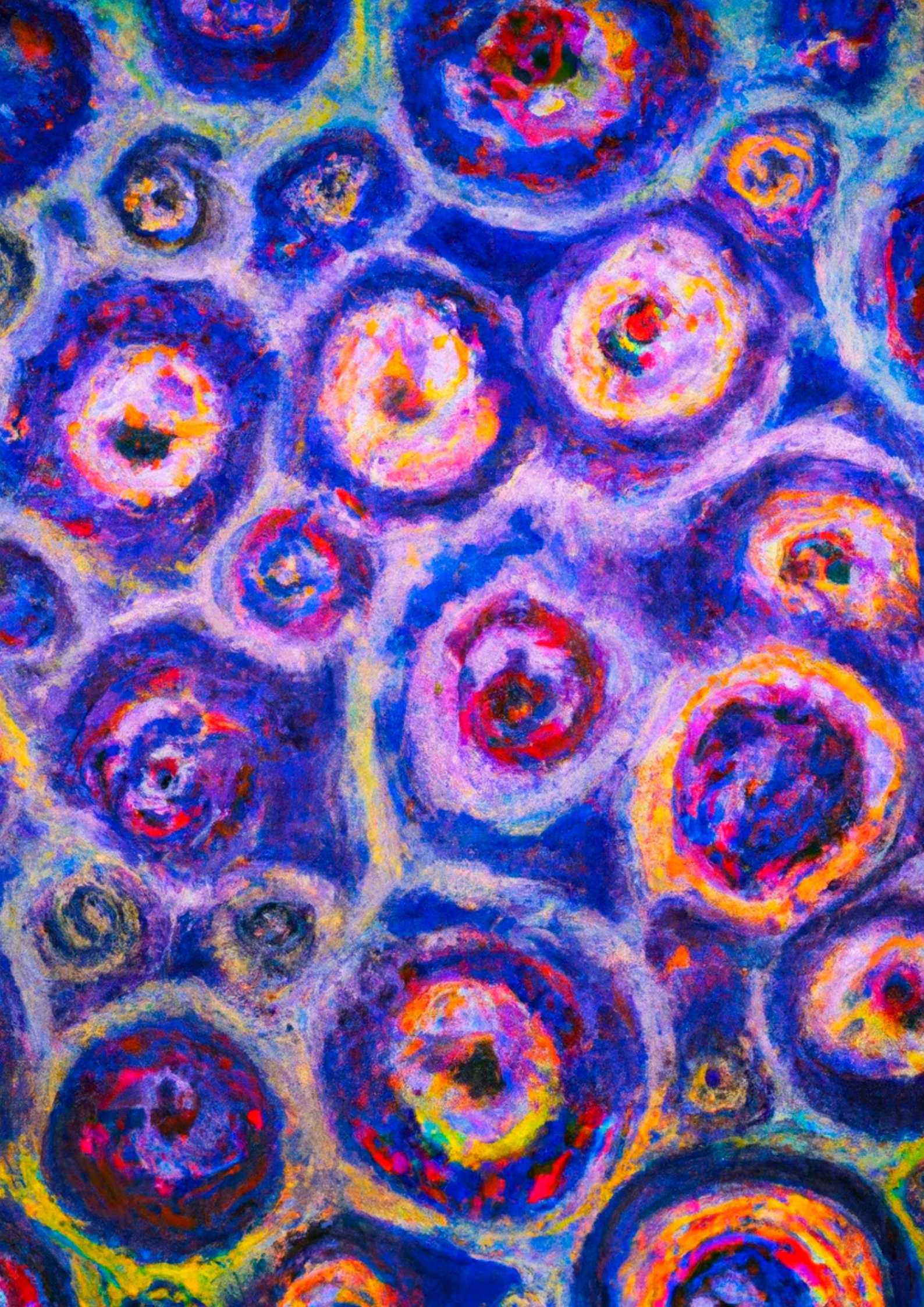
The threat potential of biological attacks as well as their possible effects in destabilizing our information and political economic ecosystems is well known. It is thus imperative that stakeholders from all levels and backgrounds endeavour to work together in addressing biological threats internationally.

Increased cooperation and collaboration between United Nations entities such as UNICRI and others engaged in complementary efforts to combat the hostile use of biology are critical. Moreover, sustained and sustainable engagement between such actors is key to ensuring the continuity of multistakeholder collaborations as the technology and capabilities surrounding biological weapons rapidly advance.

Biosafety and biosecurity education and training services will not only complement existing norms and practices, but they will also retain and update stakeholder knowledge in adapting to changing biological risks and contexts. They therefore need appropriate attention and funding.

Recommendations for BWC States Parties

Progress in biotechnology and in life sciences broadly is accompanied by emerging risks and opportunities, both of which entail a variety of interpretations and conclusions from diverse stakeholders in biosafety and security. Systematic monitoring of these risks and opportunities is needed in order to first identify significant developments. Rigorous debates covering research, policy and public engagement, among other subjects, are then important to foster scientific progress that is beneficial to all BWC States Parties. Along with partners who are already engaged in related initiatives, such activities should be sinclusive of experts from stakeholder groups including academia and industry as they could offer innovative ideas to reinforce the BWC.



Stakeholder perspectives on the Biological Weapons Convention

Recent UNIDIR reports on biological weapons-related issues

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